



NOAA
FISHERIES

SWFSC / FRD

11.2 Fishery-Independent Data Used in Billfish Stock Assessments

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Angler Survey

Tagging Data

- Conventional
- Electronic

Life History

- Stock Structure
- Foraging Ecology

Environmental

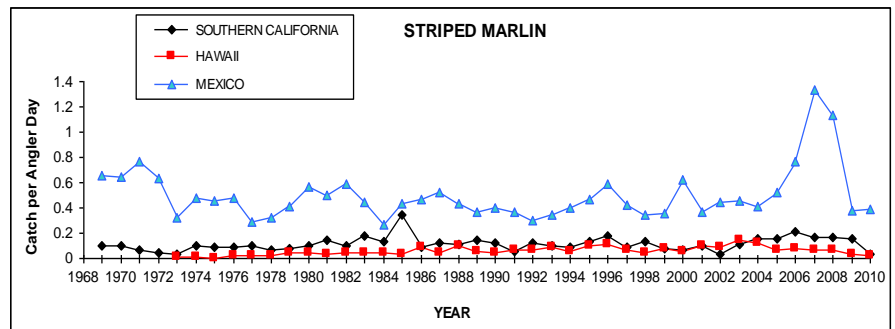
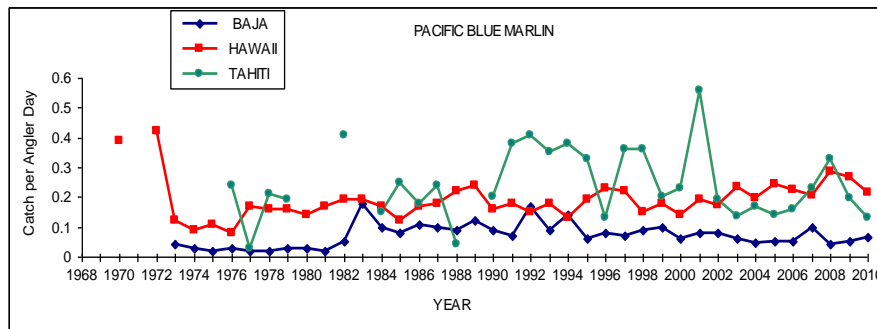
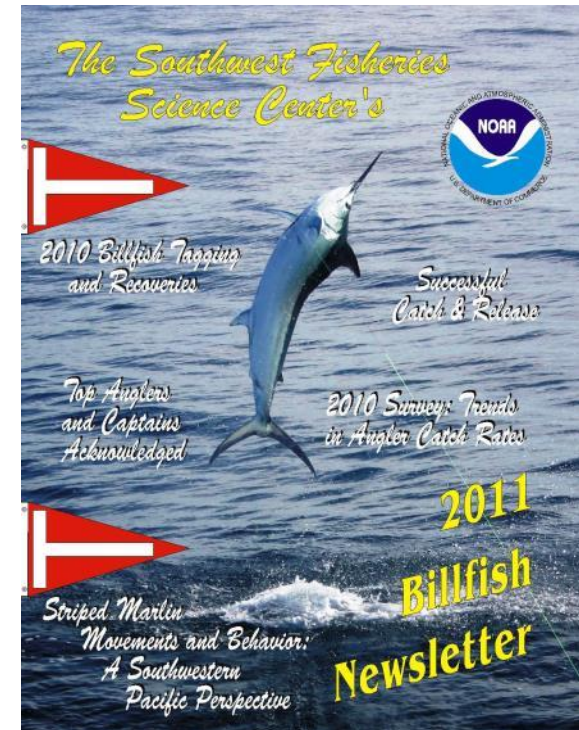
- Electronic Tagging
- Research Cruises



Billfish Conventional Tagging / Angler Survey

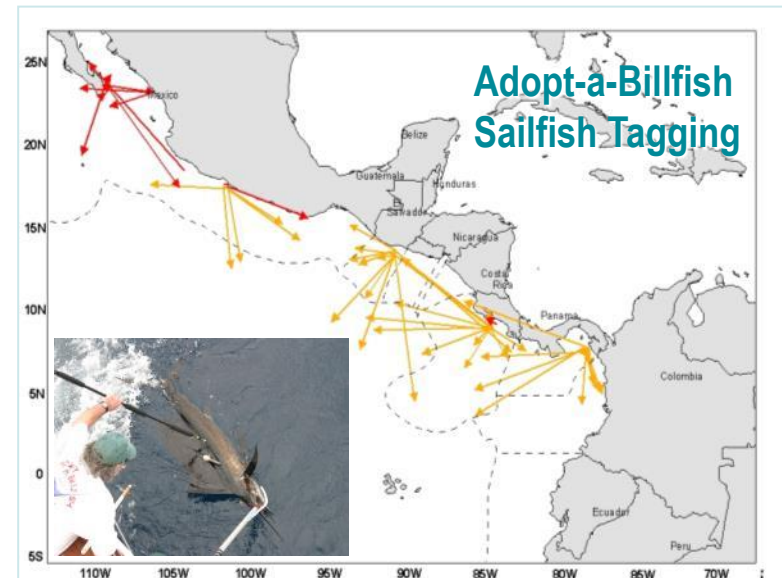
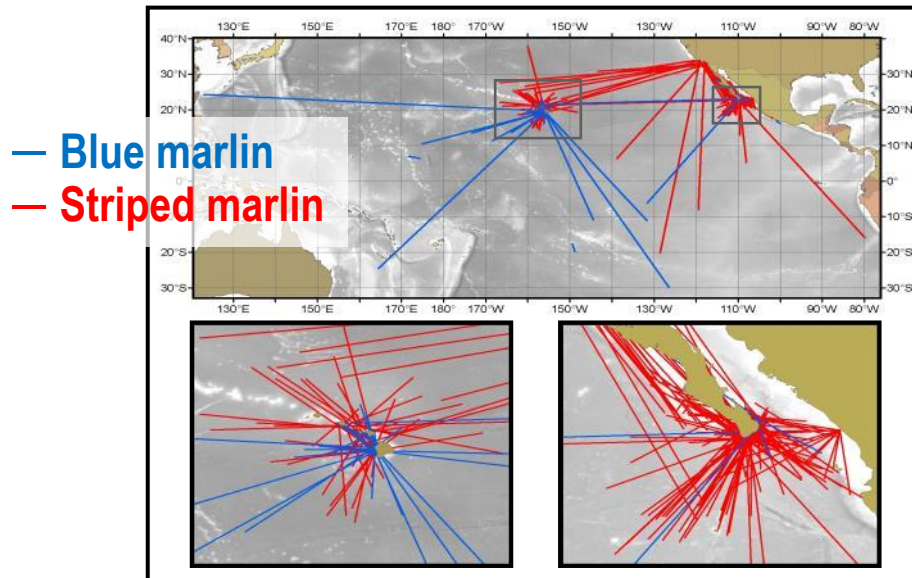
Constituent-Based

- Angler Tagging Program
 - Longest running billfish conventional tagging program
- Angler Survey
 - Provides data on recreational CPUE for use in stock assessments
- Adopt-a-Billfish
 - Funds research of billfish and electronic tag deployments



Billfish Conventional and Electronic Tagging

- Conventional tagging program was started in 1963 and is now in its 50th year
- Promotes responsible tag and release practices and provides tags to fishers with a focus on the Pacific
- Over 62,000 tags have been deployed with ~1,200 recoveries
- Collect information on growth rates, stock structure and movements
- Results demonstrate trans-boundary movements and the need for international management



Data Collected

- Date, time and location of tagging
- Species
- SST
- Estimated size and/or weight
- Tagging method and condition
- Data on effort and catch from angler surveys
- Vessel, Captain, tagger and address

Data Archives

- Single Access database contains all conventional tag deployments and recoveries
- Same Access database contains all catch and effort data from angler surveys
- Multiple Access queries and Excel files generated during analysis
- Newsletter of summaries produced annually



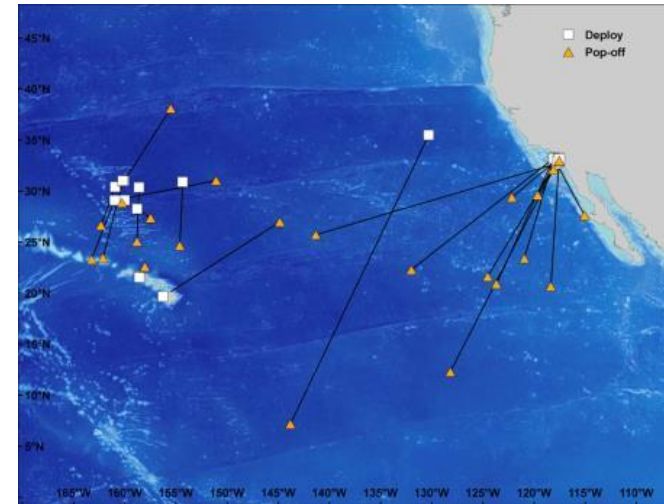
Swordfish Satellite Tagging (2006-present)

16 Traditional Pop-up Tags:

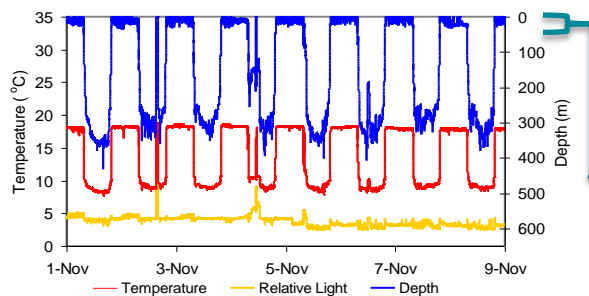
- Large and small scale movements
- Vertical habitat use

3 Towed Satellite Tags:

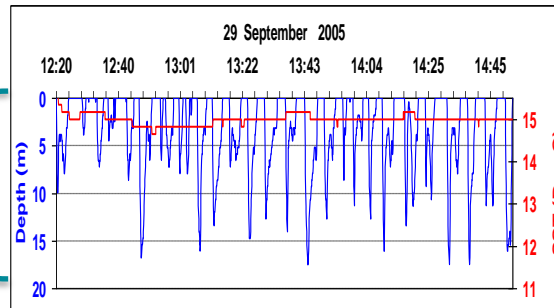
- High-resolution, fine-scale habitat use
- Link tracks to oceanography for dynamic management



Swordfish vertical movements (8 days)



Turtle vertical movements

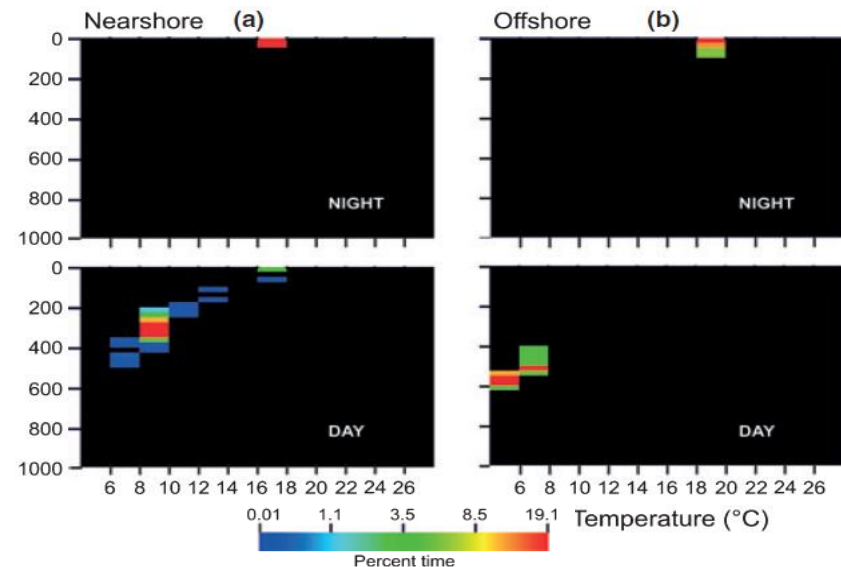
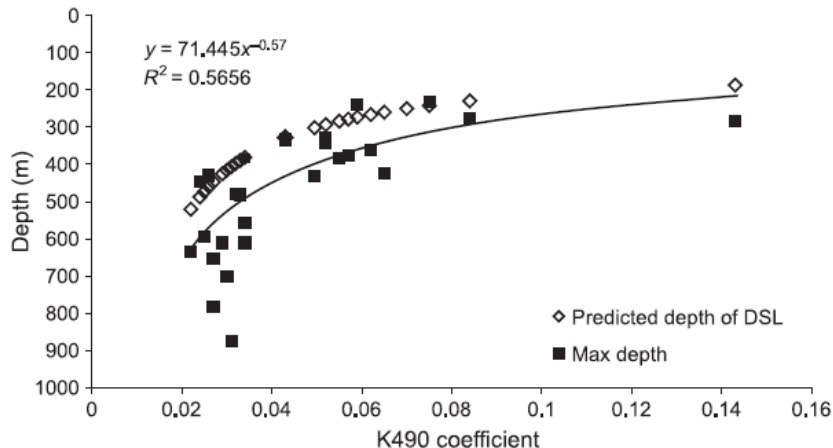


Vertical Movements

Region-specific shifts in vertical habitat use – has implications for gear vulnerability, overlap with bycatch, essential habitat

Daytime and nighttime swimming depths influenced by:

- Light attenuation
- Proximity to coast
- Temperature/ thermocline depth
- Oxygen concentration



Plot shows maximum daytime depth as a function of light attenuation. Also shown is the predicted top of the deep scattering layer.

Data Collected

- Date, time and location of tagging
- SST
- Estimated size
- Tagging method and fish condition
- Transmitted data: depth, temperature and light
- Vessel, Captain and tagger

Data Archives

- Single Access database for all deployment data
- Individual Excel files for each satellite tag
- Multiple Access and Excel files generated during tag testing and analysis



Biological Sampling of Whole Swordfish

Samples are collected by drift gillnet fishery observers and on some research cruises.

Studies aim to address:

- Foraging ecology - stomach analysis and muscle tissues for isotope analyses
- Stock structure and migration patterns - DNA, otoliths, tissues, fin spines, parasites

Swordfish Stomach Contents

- Dominant prey types are squid
- Most prey species are associated with the deep scattering layer
- Epipelagic teleosts also important component of diet
- Comparative analyses show diet most similar to blue and mako shark and less similar to common thresher shark



Top 12 prey groups from 115 swordfish stomachs in order of importance. Stomachs obtained from drift gillnet fleet observers and research surveys.

Prey species	N	F	%IRI
Jumbo squid, <i>Dosidicus gigas</i>	530	88	65.78
Boreopacific gonate squid, <i>Gonatopsis borealis</i>	611	81	23.95
<i>Abraliopsis</i> sp.	229	43	3.43
<i>Gonatus</i> spp.	159	46	2.56
Market squid, <i>Loligo opalescens</i>	172	28	1.79
Duckbill barracudina, <i>Magnisudis atlantica</i>	84	28	1.24
Chubby pearleye, <i>Rosenblattichthys volucris</i>	31	15	0.18
Pacific pomfret, <i>Brama japonica</i>	20	11	0.33
Scopelarchidae	37	13	0.20
Jack mackerel, <i>Trachurus symmetricus</i>	10	9	0.09
Pacific sardine, <i>Sardinops sagax</i>	30	5	0.08
Pacific saury, <i>Cololabis saira</i>	10	6	0.02



Otoliths / Parasites / Genetics / Tagging / Isotopes

Otolith: Preliminary analyses of otolith microchemistry and stable isotopes reveal distinct differences between fish sampled from Mexico and Hawaii

Muscle Isotopes: Isotopic analyses of muscle tissues collected off CA is consistent with residency in the California Current and not the NPTZ

Additional analyses: Focused on fin spines, genetics, and parasites

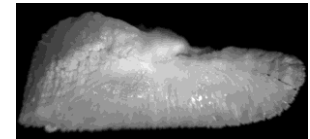
Otolith Microchemistry

 $\delta^{13}\text{C}$

Ca²⁺

Mn

Fe



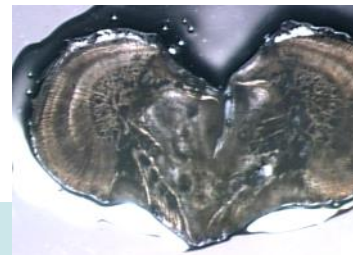
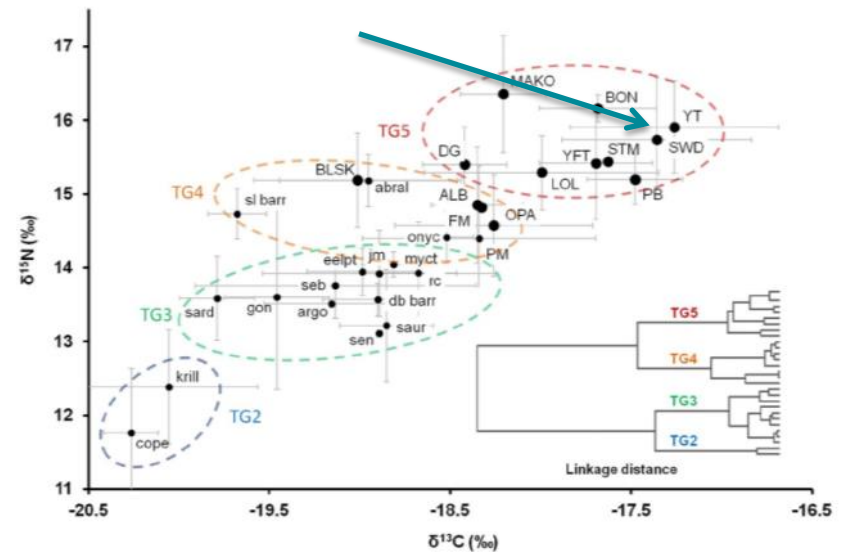
Na⁺

Ni

Ba

 $\delta^{18}\text{O}$

Sr²⁺



Data Collected

- Sample metadata (e.g. catch; location, size, date, species, fishery type)
- Number, frequency, weight and species ID of all prey
- Weight of stomach and unidentified slurry
- Spiral valve parasites
- Data associated with isotopic or microchemistry analyses

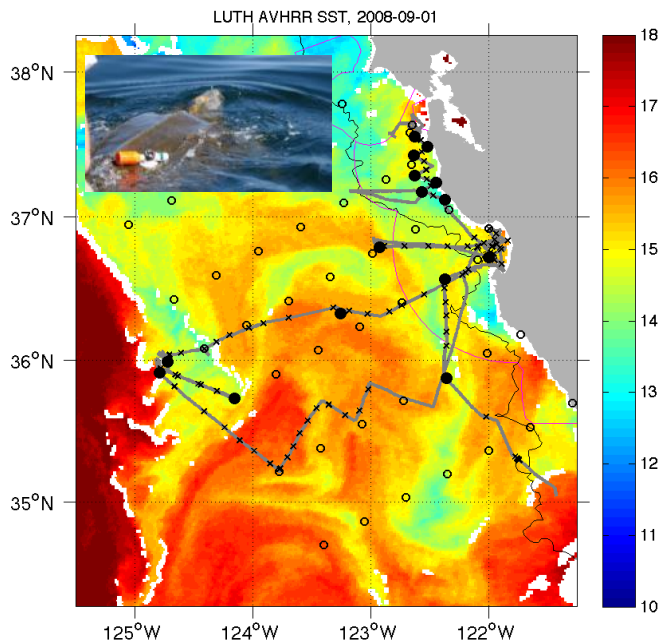
Data Archives

- Individual Access databases for data associated with prey identification and enumeration, life history data, and sample metadata
- Multiple Access, .csv and Excel files generated during data analysis

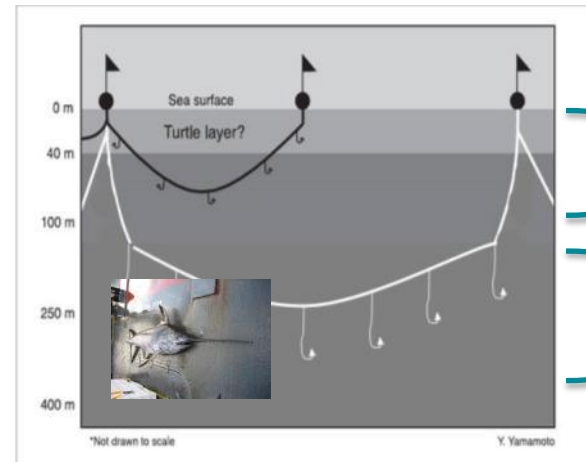
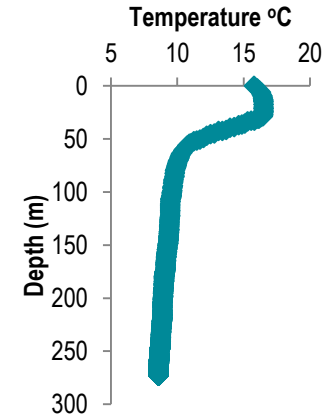
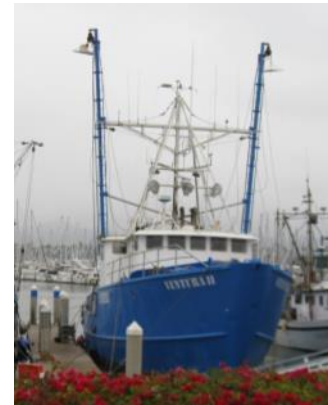


Environmental: Research Cruises and Linking Distribution with Oceanography

SLUTH



Deep Set Longline Cruises



Near-shore Daytime Depths



Data Collected

Data collected:

- Catch composition
- Life history data
- Sample metadata
- Surface and weather conditions
- Hook disposition
- CTD/ TDR profiles
- Acoustic backscatter
- Gear configuration
- Hook depth w/TDR's
- Tag deployments

Data Archives

- Individual Access database for data associated with gear configuration, set data, sample metadata, tag deployments and life history data
- Individual Excel and data files for CTD/TDR data, temperature profiles, and backscatter
- Multiple Access and Excel files generated during tag testing and analysis



Strengths

- For swordfish, established cooperation between the U.S. and Mexico and between PIFSC and SWFSC
- Angler survey and conventional tagging program provides constituent based data and is Pacific-wide
- Long time series

Challenges

- Sampling for swordfish is limited by the shrinking scale of the fishery, the size of the observer program, and the limited sizes of fish available in the U.S.
- Data types are disparate and difficult to archive in a standardized database and consequently difficult to link and analyze
- Outreach for angler-based programs limited due to lack of directed funding
- Accuracy of data and non-reporting from angler-based programs

Strategies

- If resources permit, develop online reporting system for angler surveys and conventional tagging program with associated phone app



Questions?



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